CLAIMS

1   1.   A method of forming a network from a plurality of nodes and a base station, the

2   method comprising the steps of:

3   (a) identifying at least one node of the plurality of nodes to operate as a cluster-

4   head;

5   (b) forming a plurality of clusters from the plurality of nodes, each of the clusters

6   having at least one cluster-head;

7   (c) transmitting data from at least one node in at least one of the plurality of

8   clusters to the cluster-head in that cluster;

9   (d) transmitting data from at least one cluster-head to the base station; and

10   (e) identifying a different one of the plurality of nodes to operate as a cluster-head.

1   2.   The method of claim 1, wherein the step of forming a plurality of clusters further

2   comprises the steps of:

3   advertising the availability of each of said plurality of cluster-heads; and

4   establishing a communication path between each of said plurality of cluster-heads

5   and at least one of the plurality of nodes, not operating as a cluster-head, to form a

6   cluster.

1   3.   The method of claim 2 wherein the step of establishing a communication path

2   between the cluster-head and each of the at least one of the plurality of nodes comprises

3   the steps of:

4   transmitting a status signal from each one of said plurality of cluster-heads;

5   receiving at each of the plurality of nodes one or more of the status signals;

6   comparing, at each of the plurality of nodes, not operating as a cluster-head, the

7   signal strengths of the received one or more status signals; and

8   joining a particular one of the cluster-head's cluster as a result of the comparison.

1   4.   The method of claim 3, wherein the step of joining a particular cluster is based on

2   a determination, by at least one of the plurality of nodes, of the cluster-head

3   transmitting the status signal having the highest received signal strength.

1   5.   The method of claim 2 further comprising the steps of:

2   generating at the cluster-head, a schedule having allotted slots for transmission;

3   transmitting data from at least one node to the cluster-head during the allotted

4   slots;

5   receiving data in the cluster-head that are transmitted from at least one node; and

6   transmitting data from the cluster-head to the base station.

1   6.   The method of claim 5, wherein the step of receiving data in the cluster-head

2   further comprises the step of reducing data transmission latency by using application-

3   specific data aggregation to reduce the amount of redundant data sent to the base station.

1   7.   The method of claim 5, wherein the step of receiving data in the cluster-head

2   further comprises the step of increasing the signal to noise ratio of the data sent to the

3   base station by using application-specific data aggregation.

1   8.   The method of claim 5, wherein the step of generating a schedule uses a time

2   division multiplexing protocol.

1   9.   The method of claim 5, further comprising the step of beamforming the data

2   received from the plurality of nodes in the cluster.

1   10.   The method of claim 1, wherein the step of identifying at least one of the plurality

2   of nodes to operate as a cluster-head further includes the step of randomly selecting one

3   of the plurality of nodes to be a cluster-head.

1   11.   The method of claim 10, wherein the step of randomly selecting one of the

2 plurality of nodes to be a cluster-head is based on a probabilistic function of an amount of

3 energy remaining in each of the plurality of nodes.

1 12. The method of claim 1, wherein the step of forming a plurality of clusters further

2 comprises the steps of:

3   collecting data on the status of each of the plurality of nodes;

4   assigning each of the plurality of nodes to a particular one of a plurality of

5 clusters.

1 13. A method for forming a network from a base station and a plurality of nodes, the

2 method comprising the steps of:

3   electing a cluster-head from the plurality of nodes;

4   establishing a communication path between first ones of the plurality of nodes and

5 the cluster-head to form a cluster;

6   establishing a first round of data transmission;

7   transmitting from the first ones of the plurality of nodes to the cluster-head during

8 the first data transmission round; and

9   transmitting data from the cluster-head to the base station during the first data

10 transmission round.

1 14. The method of claim 13 further comprising the steps of:

2   electing a plurality of cluster-heads corresponding to a first set of cluster-heads for

3 use during the first round of data transmission; and

4   establishing a communication path between each of the plurality of cluster-heads

5 and at least one node of the plurality of nodes to form a first plurality of clusters.

1 15. The method of claim 14 wherein the step of electing a plurality of cluster-heads is

2 performed by the base station.

1   16.   The method of claim 15 wherein the base station elects cluster-heads by

2   minimizing the energy required during the first round of data transmission.

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4   17.   The method of claim 14 wherein:

5   during the first round of data transmission, each of the at least one node in each

6   cluster transmits data to the cluster-head of that cluster; and

7   transmitting the data from each cluster-head to the base station during the first

8   transmission round.

1   18.   The method of claim 14 further comprising the steps of:

2   establishing a second round of data transmission;

3   determining whether each node of the plurality of nodes has operated as a cluster-

4   head;

5   electing a second set of cluster-heads wherein each node in the second set of

6   cluster-heads has never before been a cluster-head; and

7   forming a second set of clusters about the second set of cluster-heads.

1   19.   The method of claim 14 further comprising the steps of:

2   in each of the second set of clusters;

3   transmitting data from each node in the second set of clusters to the respective

4   cluster nodes; and

5   transmitting data from each of the second set of cluster-heads to the base station.

1   20.   The method of claim 14 further comprising the steps of :

2   establishing a second round of data transmission;

3   determining an amount of energy remaining in each node of the plurality of

4   nodes;

5   electing a second set of cluster-heads, wherein the election is based on the amount

6   of energy remaining in each node of the plurality of nodes; and

7   forming a second set of clusters about the second set of cluster-heads.

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2   21.   A network comprising:

3   a base station; and

4   a plurality of nodes comprising:

5   a cluster-head selector processor; and

6   a cluster selector processor, each cluster comprised of a subset of said

7   plurality of nodes, and one of each of said subset of said plurality of nodes temporarily

8   acting as a cluster-head.

1   22.   The network according to claim 21, wherein each of the plurality of nodes is in

2   electrical communication with a sensor.

1   23.   The network according to claim 21, wherein each of said plurality of nodes further

2   comprises a sleep mode.

1   24.   The network according to claim 21, wherein each of said plurality of nodes further

2   comprises an adjustable transmission energy level.

1   25.   The network according to claim 21, wherein each of said plurality of nodes

2   further comprises a low energy mode, and a high energy mode.

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1   26.   The network according to claim 21, wherein each of said plurality of nodes has a

2   limited amount of remaining energy; and

3   wherein the cluster-head selector processor selects each of said plurality of nodes

4   as a cluster-head based on the limited amount of remaining energy in each of said

5   plurality of nodes and the number of times each of said plurality of nodes has operated as

6   a cluster head.

1   27.   The network according to claim 21, wherein each of said plurality of nodes

2   further comprises a signal strength processor.

1   28.   The network according to claim 27, wherein the cluster selector processor

2   determines the cluster selection in response to a signal from the signal strength

3   processor.

1   29.   The network according to claim 21, wherein the base station selects each of said

2   plurality of nodes to temporarily act as a cluster-head.

1   30.   The network according to claim 21, wherein the base station determines which

2   of each of said plurality of nodes is included in each temporary cluster.